PERSONNEL RESEARCH SERIES

PRS

FCIC SIMULATED CLASSIFICATION: SOME EMPIRICAL ANALYSES OF THE DECISION-MAKING PROCESS

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Summary and Highlights

Problem

There are 23 state director positions in the Federal Crop Insurance Corporation, all classified at essentially the same level. The range of complexities and responsibilities among them is such as to lead FCIC top management to seek some objective basis for differential classification. Previous efforts to agree on variables upon which a fair, objective, and operationally useful set of standards could be developed had ended in frustration.

Method

The problem was approached through simulation and analysis of the decision-making process employed by 9 top level FCIC managers in attempting to develop classification standards. The following steps were involved.

1. The managers discussed the question: "What factors ought to be used in developing the desired estimates?" Eleven factors were agreed upon.

2. A set of 23 data sheets was prepared. Each sheet contained information on the 11 factors for a single state director position.

3. Each of the 9 managers sorted the 23 sheets into 3 piles on the basis of his individual judgment (Highest 7, Medium 9, Lowest 7). This was done twice--once on the basis of the relative level of the positions without regard to the performance of the incumbent; once taking the performance of the incumbent into account.

Results

1. The level of agreement among members of the judging group was satisfactory.

2. The ranking of the positions was not changed in any significant degree by taking the present incumbent's performance into account.

3. Analytical reconstruction of the decision-making process used by the 9 managers, showed that 2 information factors could be used that would give the same results as all 11. These were:

   (a) Ratio of total acres insured in the state in existing counties to total insurable acres in existing counties ("existing" counties are those in which crop insurance programs are currently established);

   (b) Dollar amount of premium income.

These appear to be the factors most feasible to use in attempting to develop standards for differential classification of FCIC state director positions.

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FCIC SIMULATED CLASSIFICATION: SOME EMPIRICAL ANALYSES OF THE DECISION-MAKING PROCESS

Introduction

The top management group of the Federal Crop Insurance Corporation (FCIC) asked the Personnel Research Staff (PRS) to conduct a study of their process of estimating the relative level of FCIC state director positions.

This request grew out of a description by FCIC management of a wide range of complexity and responsibilities among the 23 state director positions--the top field positions in FCIC--and an expressed need to identify standards that might provide some objective basis for differential classification of these positions. At present they are all classified at the same level.

Previous attempts to agree on variables upon which a fair, objective and operationally useful set of standards could be developed had ended in frustration.

It was thought that some clarification of the problem involved might be obtained by simulation and analysis of the decision-making process FCIC top management employed in attempting to develop classification standards.

The following report presents the procedural steps involved and the empirical results of this study.

The Factors

Several sessions were held in which the group discussed the question: "What are the factors that ought to be used in developing the desired estimates?" Some of the factors considered appeared to be nearly identical or were composites of other factors. For other factors, information on all state director positions could not be readily obtained. A consensus was finally achieved that information about the 23 state director positions would be developed on the following eleven factors:

1. Ratio of total acres insured in the state in "existing" counties to total insurable acres in "existing" counties ("existing" counties are those in which crop insurance programs are currently established)

2. Dollar amount of premium income

3. Amount of insured liability

4. Number of crops insured

5. Number of crop cancellations

6. Number of counties with programs

7. Number of crops earning premiums

8. Number of contracts in force

9. Number of potential insurable crops

10. Number of insurance units insured

11. Number of different commodities insured

The Data

Information on the above eleven factors was obtained from FCIC records for each of the 23 state director positions. A set of data sheets was then prepared with each sheet containing the information on the eleven factors for a single state director position.

Each of the nine top level managers of FCIC who participated in this phase of the study was given two sets of the twenty-three information sheets. Each participant was told to use the information provided to sort each set into three piles on the basis of his individual judgment, as follows:

State Director Position Level		
Highest	Medium	Lowest
7	9	7

The participants were not allowed to communicate with one another during the sorting procedure.

The first set was sorted on the basis of the relative level of the positions as currently constituted without regard to the performance of the incumbent. The second set was sorted on the basis of the relative level of the position as performed by the present incumbent. The verbatim instructions are given in Appendix A. The positions were not identified by state for the first sorting, but were for the second sorting.

The two separate sortings were used to deal with the questions raised in the earlier discussions: "Should the performance of present incumbents be considered in deciding upon the level at which to place the positions? Would it make a difference in the way in which the 23 positions were ranked by the judges?"

To simplify further reference we will hereafter identify the first "level alone" sorting as L, and the sorting that included performance considerations as L+P.

A twelfth information item that was obtained for use in later analyses, but not for use by the judges, was the length of time each state director had served in that capacity. This variable was included to see whether it had any influence upon the judgments of the participants.

The Analyses and Results

Agreement among the participants. Each position was scored 9 times, one score from each judge, on the basis of the sorting process described above: Highest 2, Medium 1, and Lowest 0. The sortings were first analyzed to determine the extent of agreement among members of the judging group.

The intraclass correlation for L sortings was .62. For L+P it was .73. (1.00 would represent perfect agreement; 0.00 complete absence of agreement.) The computational rationale for this index and the variance components are given in Appendix B.

For data of this kind, when each person must assign a specified number of sheets to each pile, intraclass correlations in this range are quite adequate and indicate a fairly high degree of agreement among the group members. This made it legitimate and desirable to combine the nine judgments into one average score for each of the state director positions.

Correlation of L with L+P scores. The average L and L+P scores were then correlated. The correlation obtained was .89 which, taking into account the reliability of the original judgments, indicated that the ordering of the positions was almost identical for these two sets of pooled judgments.

Even though these differences were slight it was decided, as a further check, to separately relate the information factors to the average L and L+P scores. It was thought that the L scores might be better reproduced by the factors than would the L+P scores, since information not contained in the factors might be taken into account in judging performance. The factor of "time served in position" was introduced into the analysis at this point.

The intercorrelations among the factors are given in Appendix C.

Factors influencing the decision process. "What factors most influenced the decisions of our FCIC top-level executives as to the order in which to place the state director positions?" Posed in analytic terms the question becomes: "How close can we come to reproducing the ranking of the 23 state director positions obtained from the average score assigned by the 9 judges, using the 12 information factors?" This may be thought of as an analytical reconstruction of the decision-making process in which the "average score rank" is regarded as the best available overall decision.

The technique employed is known as "multiple regression analysis." The manner in which this technique utilizes information is explained in Appendix D. How well this technique reproduces the pooled judgments is expressed by a squared multiple correlation coefficient (SMC) that ranges from 0.00 for absence of any accurate reproduction to 1.00 for completely accurate reproduction of the average score rank.

Influence of factors upon decision. The first question to be answered is: "Does length of time served in the state director's position contribute any information, not already supplied by the other factors, in reproducing the average L or L+P scores?" Exhibit 1 shows the SMC obtained when "length of time served" was included and when it was excluded from the analysis with the eleven other factors. These figures show that inclusion of "length of time served" did not make any appreciable difference in the results.

Exhibit 1

Squared Multiple Correlation When "Length of Time Served" Is Included and Excluded from the Analysis

	Level	Performance	Diff.
Included	SMC = .90	SMC = .86	.04
Excluded	SMC = .90	SMC = .85	.05
Difference	.00	.01	

Exhibit 1 also shows that there is not any practical difference between the SMCs for L and for L+P. They can both be reproduced with a very high degree of accuracy.

The next question to be answered is: "Which of the eleven factors best reproduce the L and L+P scores?" The SMCs for L and L+P were .88 and .85 respectively, using the "best" four factors in each instance. These four factors were 1, 2, 3 and 6 for L, and 1, 2, 7 and 9 for L+P. (See the list of factors, page 1.)

Since there is no appreciable difference in the accuracy with which these two sets of scores can be reproduced and since the two sets of scores were shown to be very highly correlated (.89), the slight differences that do exist between them can be attributed to the disagreements among the members of the group in arriving at their decisions. If there was a greater degree of agreement among the group members in arriving at their decisions the correlation between the two sets of scores would be even higher. Since the L and L+P scores could be regarded as being essentially similar, the next question was: "How accurately could factors 1 and 2, which were among the four "best" for both sets of scores, reproduce the average scores?" The L score was considered to be the conceptually clearer of the two. When this analysis was performed the SMC obtained with L was .83.

This appears close enough to the maximum obtainable with all factors to suggest that the use of these two factors alone would suffice for all practical purposes:

(a) Ratio of total acres insured in the state in existing counties to total insurable acres in existing counties

(b) Dollar amount of premium income

Use of additional factors, which would have relatively minor weights, would require more work without making any appreciable difference in the decision arrived at.

To combine these factors they should first be ranked and added up by giving (a) a weight of 1, and (b) a weight of 2 (i.e. 2(b) + 1(a) = Weighted Rank). A comparison of the ranks obtained on the basis of these two factors and the average score rankings is given in Exhibit 2.

Inspection of Exhibit 2 shows that the six states highest on "weighted rank" are the same six to which the judges assigned highest "average score ranks" (d, j, p, r, s, u). Similarly the six lowest on "weighted rank" are among the seven lowest in "average score rank" (b, e, g, i, l, n).

Conclusion

If one accepts the premise that the pooled judgment of the relative level of state director positions, made by the nine FCIC executives who participated in this simulated decision-making process, represents an operationally valid criterion, then it would appear that they could arrive at practically the same decisions if they used only the two factors of information indicated.

This suggests that these two factors are likely to be most suitable for consideration in dealing with the problem of establishing a basis for differential classification of FCIC State Director positions. While the finding of this research does not define the standards for such classification, they do point to the kinds of information that probably would be most useful in developing such standards.

Exhibit 2

Comparison of Rankings Obtained from Weighted Factors with Average Score Rank

State Identification	1 (a)	2 (b)	Weighted Rank	Av. Score Rank
a	3	13	10.5	11.5
b	23	23	23	19
c	10	19	16.5	21
d	7	3	4	2.5
e	16	17	18	21
f	19	11	13	16
g	20.5	22	22	21
h	18	15	16.5	9
i	20.5	18	19	23
j	13	6	6	5
k	11	9	10.5	14
l	17	21	20	17.5
m	18	12	14	14
n	22	20	21	17.5
o	1	14	10.5	14
p	2	5	3	6
q	6	10	7	9
r	9	4	5	4
s	5	2	2	1
t	14	16	15	9
u	4	1	1	2.5
v	15	7	10.5	7
w	12	8	8	11.5

Note:

(a) Ratio of total acres insured in the state in existing counties to total insurable acres in existing counties

(b) Dollar amount of premium income

APPENDIX A

Instructions to the Participant

You have been given 2 stacks of 23 sheets. On each sheet are listed the data for 11 variables that we agreed to include in the experiment. Each sheet represents one state director position.

The experiment is divided into two phases. In each phase you will sort the sheets into 3 piles as follows:

High = 7 sheets

Medium = 9 sheets

Low = 7 sheets

The way to do this is to first go through the stack and pick out the 7 highest sheets and set them aside. Then go through the stack and pick out the 7 lowest sheets. This will leave 9 remaining sheets in the middle or medium pile.

The basis for sorting in each phase will be as follows:

Phase 1 = Sorting exclusively on the basis of the relative level of the job. In making these judgments think of the position as being unoccupied. Otherwise you may take the variables into account in any way that you see fit to arrive at *your* judgment of the level at which the position should be put, but you must conform to the distribution established.

When you complete Phase 1 circle the Ls for the low pile, the Ms for the medium pile, and the Hs for the high pile. Then assemble the piles so that Low is on the bottom, Medium in the middle and High on the top. Put the cover sheet on the stack and initial it, then proceed to Phase 2.

Phase 2 = Sorting on the basis of the relative level of the job as performed by the present incumbent. In making these judgments take into account, as you deem appropriate, the performance of the present incumbent.

When you complete Phase 2 circle the Ls for the low pile, the Ms for the medium pile and the Hs for the high pile. Then assemble the piles so that Low is on the bottom, Medium in the middle and High on the top. Put the cover sheet on the stack and initial it.

APPENDIX B

Computational Rationale and Variance Components for Intraclass Correlation

The computational rationale for this procedure is taken from Ebel, R. L. Estimation of the Reliability of Ratings, Psychometrika, 16(4), December, 1951, pp. 407-424 as follows:

Analysis of Variance for Level (L)

Source	Degrees of Freedom	Sums of Squares	Mean Square	Components of Variance
State director positions (p)	22	82.2	3.74	$\sigma_e^2 + 9\,\sigma_p^2$
Error (e)	184	43.8	.24	σ_e^2
Total	206	126		

$$\text{Intraclass } r = \frac{3.74 - .24}{3.74 + 8(.24)} = .62$$

Analysis of Variance for Level Plus Performance (L+P)

Source	Degrees of Freedom	Sums of Squares	Mean Square	Components of Variance
State director positions (p)	22	94.89	4.31	$\sigma_e^2 + 9\,\sigma_p^2$
Error (e)	184	31.11	.17	σ_e^2
Total	206	126		

$$\text{Intraclass } r = \frac{4.31 - .17}{4.31 + 8(.17)} = .73$$

APPENDIX C

Exhibit 3

Factor Means, Standard Deviations and Intercorrelations

	a 1	b 2	c 3	d 4	e 5	f 6	g 7	h 8	i 9	j 10	k 11	l 12	m 13	n 14	Mean	S.D.
a	1.00	.31	.22	-.04	-.27	-.49	-.05	-.13	-.53	-.05	.22	.27	.38	.59	18.29	14.06
b	.31	1.00	.81	.52	.24	.23	.55	.48	.05	.61	.21	-.03	.88	.84	1234175.00	800536.24
c	.22	.81	1.00	.65	.44	.27	.70	.65	.27	.77	.39	-.21	.81	.70	21499697.00	16375064.00
d	-.04	.52	.65	1.00	.78	.44	.99	.86	.65	.94	.36	.05	.55	.43	18177.22	15759.66
e	-.27	.24	.44	.78	1.00	.62	.81	.92	.70	.82	.17	-.11	.34	.12	3300.04	2494.49
f	-.49	.23	.27	.44	.62	1.00	.49	.66	.65	.54	.02	-.16	.35	.02	47.65	22.45
g	-.05	.55	.70	.99	.81	.49	1.00	.91	.66	.98	.36	.01	.58	.45	14306.83	12172.14
h	-.13	.48	.65	.86	.92	.66	.91	1.00	.62	.95	.34	-.09	.53	.36	12615.35	9304.26
i	-.53	.05	.27	.65	.70	.65	.66	.62	1.00	.62	.07	-.04	.17	-.17	114124.65	71544.95
j	-.05	.61	.77	.94	.82	.54	.98	.95	.62	1.00	.39	-.08	.62	.48	20125.26	16824.16
k	.22	.21	.39	.36	.17	.02	.36	.34	.07	.39	1.00	.09	.20	.23	5.26	1.68
l	.27	-.03	-.21	.05	-.11	-.16	.01	-.09	-.04	-.08	.09	1.00	-.01	.12	55.52	6.56
m	.38	.88	.81	.55	.34	.35	.58	.53	.17	.62	.20	-.01	1.00	.89	99.78	64.47
n	.59	.84	.70	.43	.12	.02	.45	.36	-.17	.48	.23	.12	.89	1.00	99.83	69.03

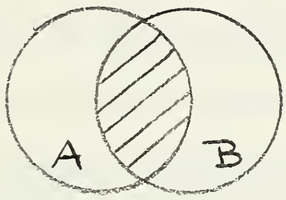
a - Ratio of total acres insured in existing counties to total insurable acres in existing counties
b - Dollar amount of premium income
c - Amount of insured liability
d - Number of crops insured
e - Number of crop cancellations
f - Number of counties with programs
g - Number of crops earning premiums
h - Number of contracts in force
i - Number of potential insurable crops
j - Number of insurance units insured
k - Number of different commodities insured
l - Length of time as state director
m - Average level (L)
n - Average performance (L+P)

APPENDIX D

The Utilization of Information in Multiple Regression Analysis

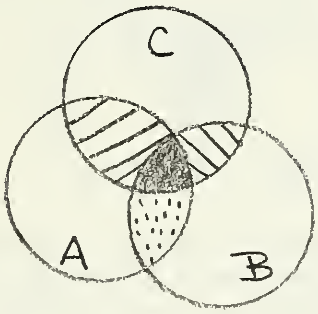
The manner in which this mathematical technique utilizes information is best illustrated by a few simple diagrams.

Suppose that we have two categories of information that are of interest to us. These can be represented by means of two overlapping circles or sets labeled A and B. The area of overlap, the shaded area, represents that information which is common to both A and B.



Suppose we wanted to add up everything in A and B by adding first everything in A and then everything in B. In doing this we would have counted everything in the shaded area twice, once when counting A and once when counting B. In order to be correct in our arithmetic we only want to count the shaded area once, hence we would subtract it once (A + B = A + B -).

Now let us complicate the picture a little by introducing a third set C.



and let us define the following areas:

- that information in the intersection of all three sets;

- that information common to B and C which A does not have;

- that information common to A and C which B does not have;

- that information common to A and B which C does not have.

If we wanted to add up everything in all three sets, A + B + C, we would end up counting the dotted and slanted areas twice each and the solid area three times. To correct for this we would subtract the dotted and slanted areas once each and the solid area twice, i.e.
A + B + C −  −  −  − 2  .

We could make the picture increasingly complex by adding more sets of information, however, this example is sufficient. Let us ascribe some meaning to these categories of information.

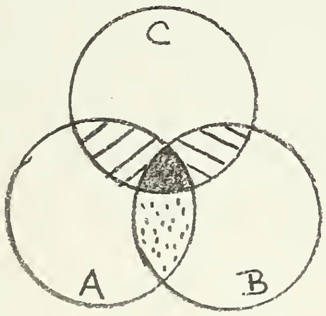
Let us now assume that A, B, and C are three measures on a group of people:

A = Score for each person representing his qualifications;

B = Score for each person representing his characteristics;

C = Score for each person indicating his "Readiness for Promotion."

In this context multiple regression analysis would attempt to ascertain the manner in which categories A and B are combined to arrive at an individual's "Readiness for Promotion" score. The outcome would be a set of weights assigned to each category of information so that when combined they provide the "Readiness for Promotion" score. The weights are assigned to these categories so as to maximize their relationship with the "Readiness for Promotion" score and minimize the amount of overlap between categories A and B. Thus, in the following example:



The solid area would be counted as part of A and then in assigning a weight to B the solid area would not be counted again. Thus, B would play a much smaller part in determining C than would A.

An individual's A score would then be multiplied by the weight for A, his B score by the weight for B, and then these two weighted scores would be summed in order to arrive at an estimated C score. A measure of the adequacy with which the C scores are estimated by this weighting system is called the multiple correlation. This value varies from 1.00 for perfect estimation to .00 for lack of any relationship.